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Solar Power Optimization Tool for Onsite Needs (SPOT-ON) User's Guide

by David Sauter

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14. ABSTRACT

Electric power generation from flexible-type solar collectors can be used in a tactical military environment to provide and/or augment power requirements. This technical note describes an easy to use mobile application that determines how much energy can be generated on a daily basis.

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1. Introduction

The Solar Power Optimization Tool for Onsite Needs (SPOT-ON) application (henceforth also referred to as the “app”) provides information on the peak electrical power and daily energy that can be generated by a solar collector as a function of the geographic location, date and time, surface type, cloud amount and type, and collector efficiency. SPOT-ON is intended to support tactical power generation and augmentation via the use of primarily flexible solar collectors that would typically be laid flat on the ground. SPOT-ON is hosted on Android-based smartphones and tablets (referred to from here on as the “device”).

2. SPOT-ON Inputs

To launch SPOT-ON, tap the SPOT-ON icon on the mobile device (figure 1). The initial input tab is then displayed for the user to enter the site information (figure 2). The latitude and date are used to compute the solar altitude via the “solarposition” computer algorithm (Liljegren, 2008) which is based on formulations in the Astronomical Almanac (U.S. Naval Observatory, 1990). The solar altitude, in turn, is required to calculate the clear sky irradiance value beginning at midnight local time and then every 30 min thereafter for 24 h (used to compute the total energy available in a day). The surface input is used by the app to assign a surface albedo (Sellers, 1965) which affects the resultant irradiance value. See table 1 (or figure 3) for the listing of available surface types (displayed after tapping the existing surface type name to the right of the “Surface” text). Table 1 lists the fractional albedo value associated with each surface.

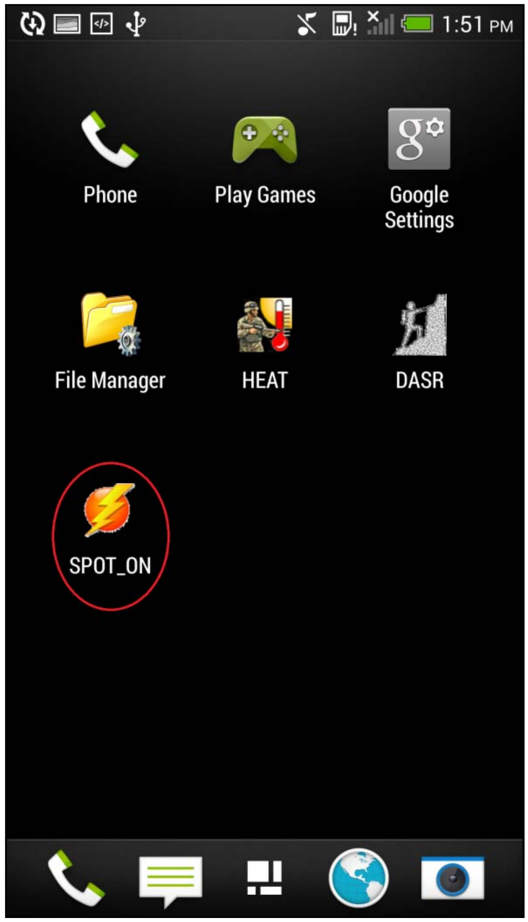

Figure 1. Launch SPOT-ON.

Figure 2. SITE view.

Table 1. Surface type and fractional albedo.

Desert, Light soil	0.30
Deciduous forest, Green meadows	0.15
Coniferous forest, Dark soil	0.10
Fresh snow	0.85
Snow	0.55
Crops	0.20

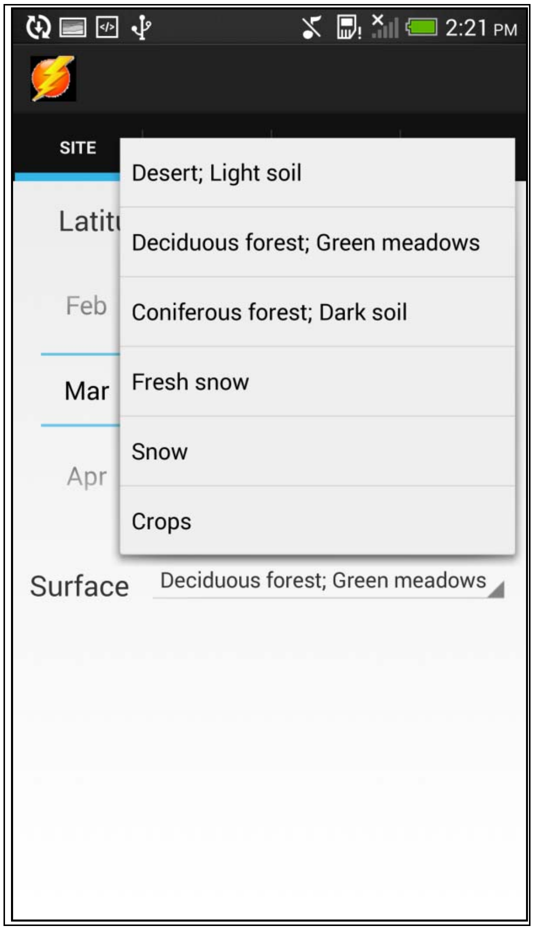

Figure 3. Surface choices.

Figure **4** displays a screen capture of the "MET" (meteorological) tab that allows user entry of the cloud amount (tenths) and type. This screen is displayed by tapping the "MET" tab at the top of the app display. Photos of each of the cloud types are displayed to assist the user in determining the appropriate choice. The cloud inputs are used to determine the attenuated irradiance value (Shapiro, 1982) which will provide a more realistic estimate of the electrical generation capability of the collector(s). The user can also enter a value for the solar collector efficiency in converting solar irradiance into electrical energy. Collectors available for tactical use are typically on the order of only 10%–15% efficient. Note: As this app was designed to support tactical military operations in which logistics (transport, setup and teardown, etc.) will likely be a primary concern, it is assumed that the collectors will generally be of a flexible design that can be folded and/or rolled. This design, coupled with use in a tactical environment, assumes that the collectors will be deployed on the ground such that they are in a generally horizontal orientation. This assumption also simplifies the determination of the overall electrical energy generation as it is not necessary to make more involved irradiance calculations as a function of the collector/solar azimuth offset.

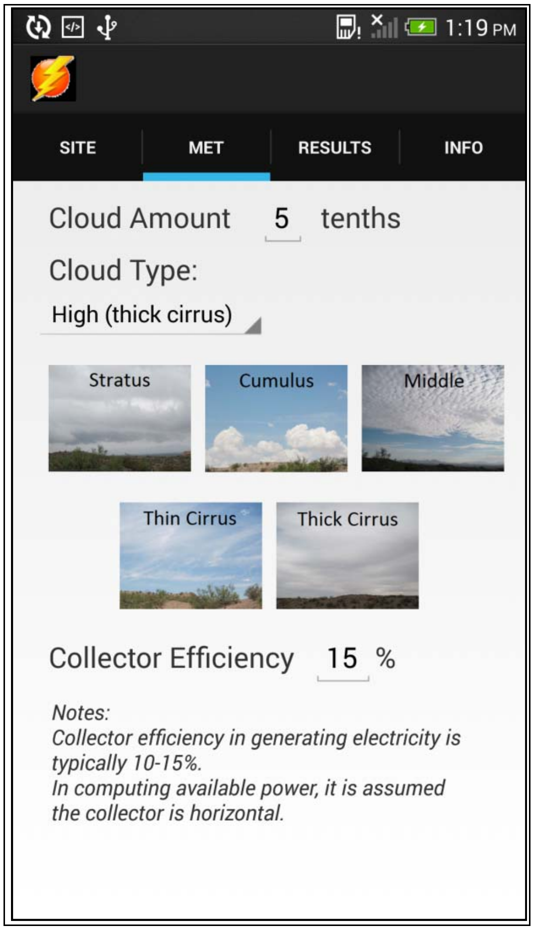

Figure 4. MET view.

3. SPOT-ON Output

Tapping the “RESULTS” tab will calculate and then display (figure 5) the total electrical energy available during the day, the peak power output and the optimal tilt angle for the collector(s) in the event it can be oriented other than horizontal. The energy value result is for a 1 m2 solar collector. Thus, multiplying the total area (in m2) of all the deployed solar collectors by the displayed energy value will provide an estimate of the daily electrical energy production.

The final tab (“INFO,” figure 6) provides point of contact information as well as the version of the installed app.

Upon app exit, current values for all of the user inputs will be stored such that they will be the default values displayed when the app is next run.

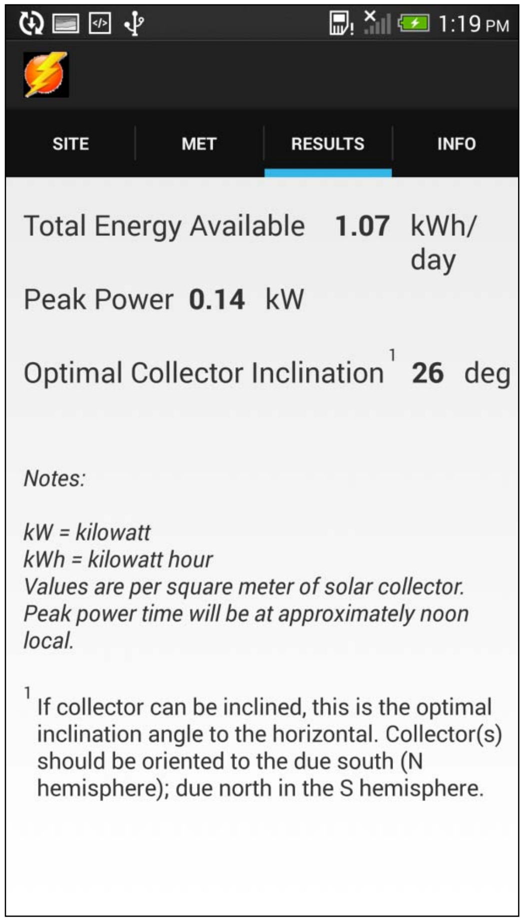

Figure 5. RESULTS view.

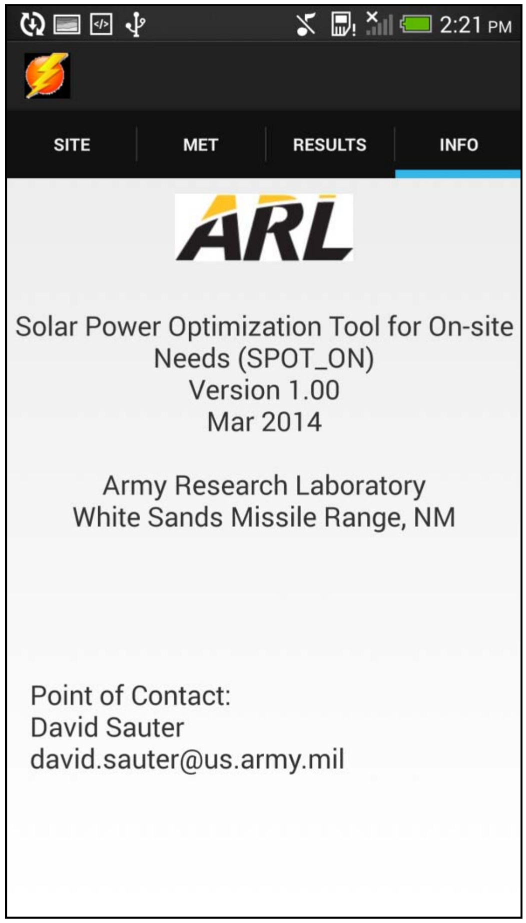

Figure 6. INFO view.

4. Summary and Conclusions

SPOT-ON provides an easy to use capability to estimate available electrical energy and power generation values given simple readily available inputs. Hosting on a mobile device should make it accessible virtually anywhere in a tactical environment.

After internal testing and evaluation (2014) the app will be submitted to the Defense Information Systems Agency (DISA) Mobile Application Store (MAS) for validation and with plans for eventual availability to Department of Defense (DOD) users.

4. References

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